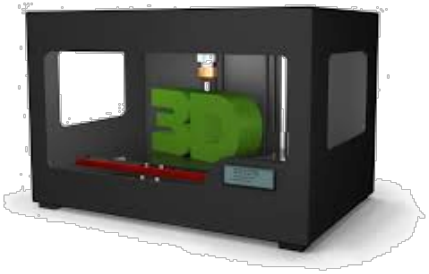
THE POTENTIAL OF 3D PRINTING TO REDUCE THE ENVIRONMENTAL IMPACTS OF PRODUCTION

CATRIONA MCALISTER - JONATHAN WOOD

3D PRINTING TECHNOLOGY

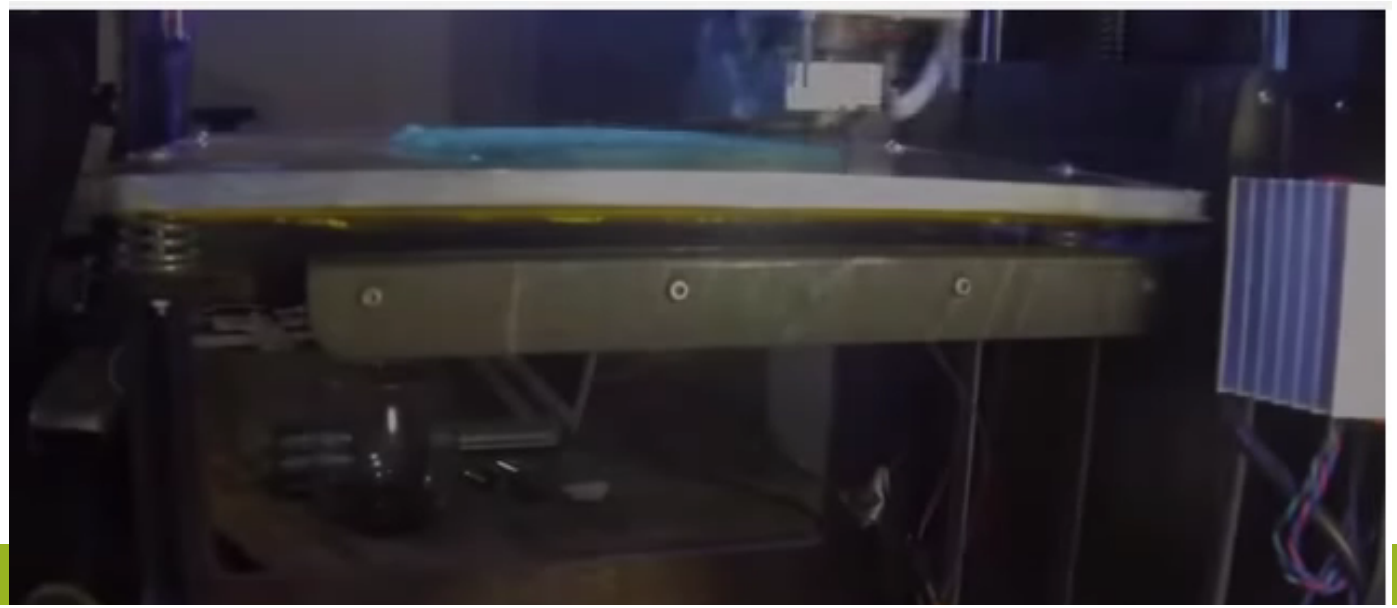
- What is it?
- What's all the fuss about?
- What's the truth about 3D printing?
- What are the environmental impacts?
- How can 3D printing technology improve the sustainability of production?
- How can the impacts of 3D printing be reduced?



WHAT *IS* 3D PRINTING?

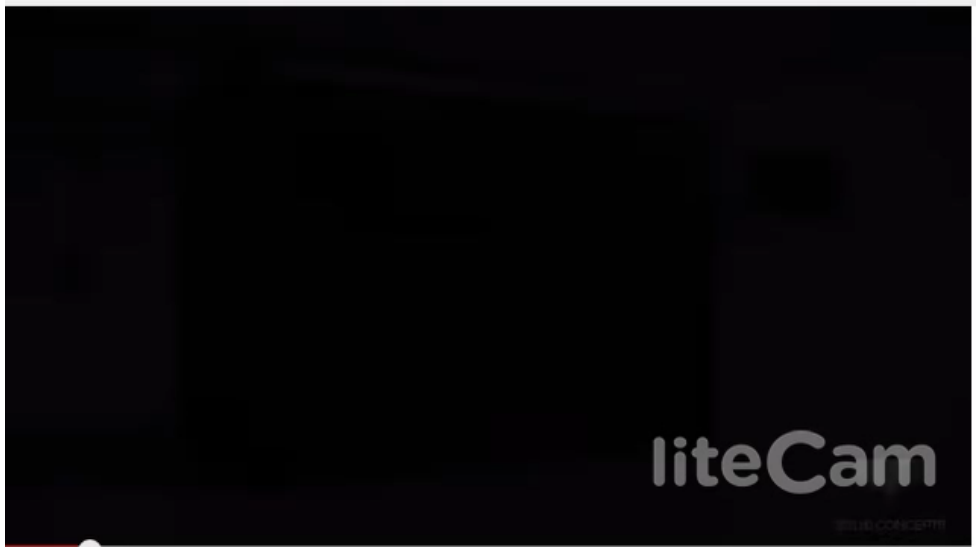
- It's not new! 3D printing has been around since 1984
  - "additive manufacturing"
  - "rapid prototyping", "rapid manufacturing"
  - "stereo lithography"
  - "selective laser sintering"

- Printing 3D solid objects from a digital model by laying down successive layers of material
- Can be combined with "subtractive" manufacturing
- New applications due to reductions in costs.
- Domestic users getting in on the act



THE MAIN TYPES OF 3D PRINTING TECHNOLOGY

- Light polymerized
  - E.g. Photo polymer / liquid resins and gels
- Extrusion based
  - E.g. Thermoplastics in filament form
- Granular material binding…
  - E.g. Other polymers, elastomers, metal alloys, and ceramic powders.



WHAT'S ALL THE FUSS ABOUT?

Manufacturing contemplates a 3-D printing revolution

Companies adopting the technology wax enthusiastic about its potential, which could be 'profound'

3D printing to lead way in manufacturing revolution

"3D printing has the potential to **revolutionize** the way we almost **everything**"

-- Barack Obama, U.S

3D Systems' Revolutionary Mass Manufacturing 3D Printing System

The 3D Printing Revolution Has Begun

layer-by-layer… It gives everyday consumers the power of manufacturing.

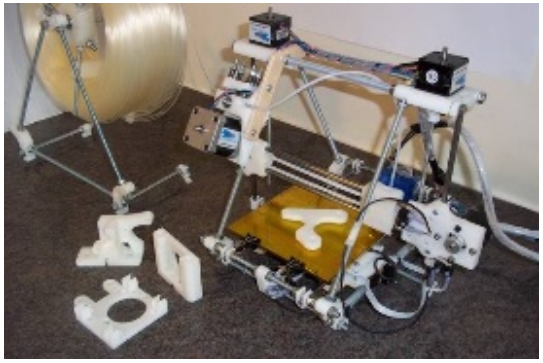
WHAT'S ALL THE FUSS ABOUT?

WHAT'S ALL THE FUSS ABOUT?








WHAT'S THE TRUTH ABOUT 3D PRINTING?

3D printing: Don't believe all the hype

Summary: *The technology is interesting, but the novelty will eventually wear off.*

3-D Printer Makers Get Reality Check

Toughest Job for ExOne's President: Managing the Hype

Surge in 3-D-printing stocks largely hype, analysts say

UNLESS IT'S A TOY GUN

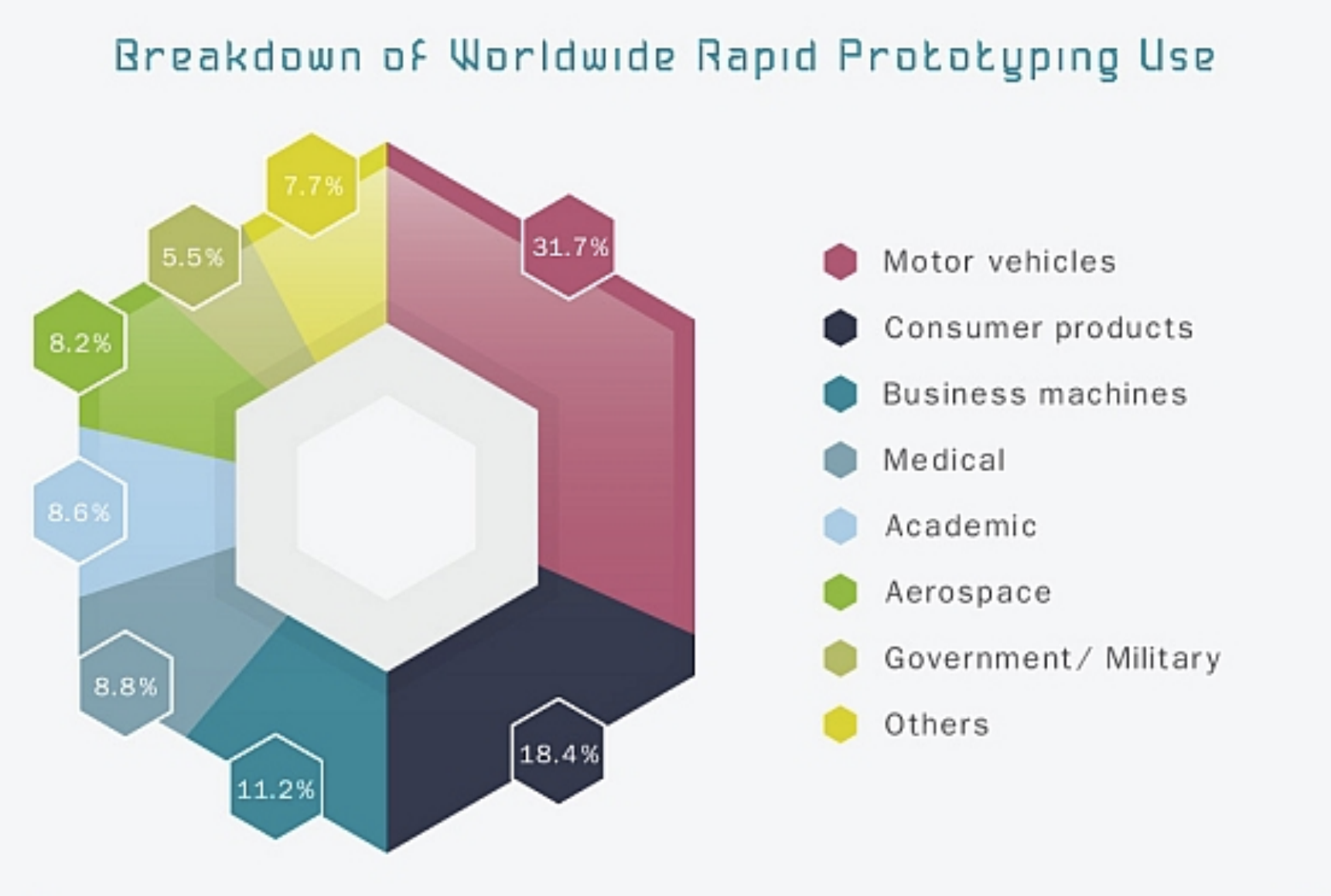
The father of 3D printing says it's overhyped

Has 3D printing in the home been over-hyped?

WHAT'S THE TRUTH ABOUT 3D PRINTING?

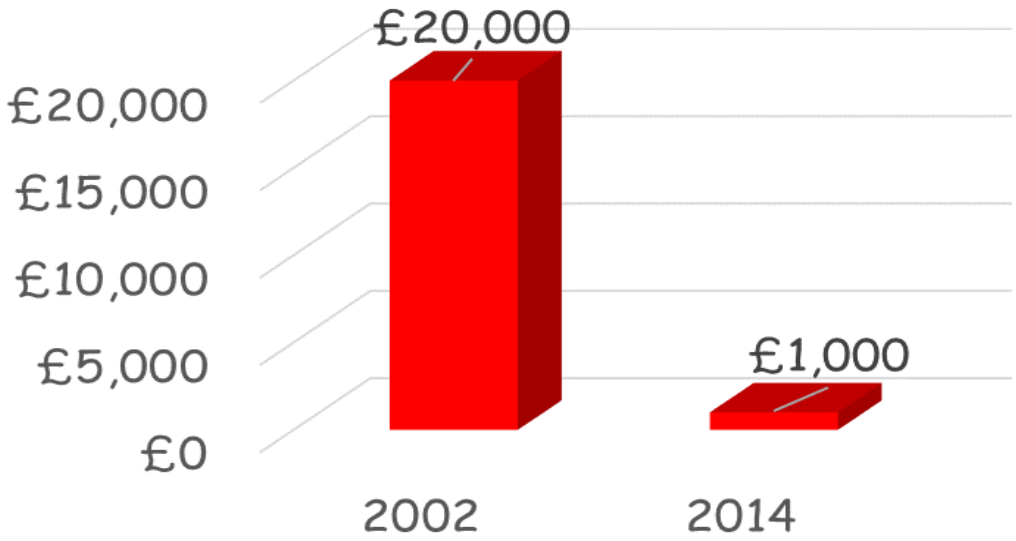
Strengths **S** **Reduced design constraints** **Reduced number of parts** Efficient use of materials **Reduced supply chain** **Negates dedicated tooling** Reduced labour cost Less barrier to market	**Weaknesses** **W** Limited material variety Cost **Speed and volumes** Usability Printer proliferation **Strength, durability and tolerances**
Opportunities **O** **Customised products** Cheap small production runs Physical testing Job creation (new) Manufacturing repatriation End to obsolescence (?) Drive to innovation	**Threats** **T** Copyright and ethics Consumer rights Frivolous printing Job losses (traditional)

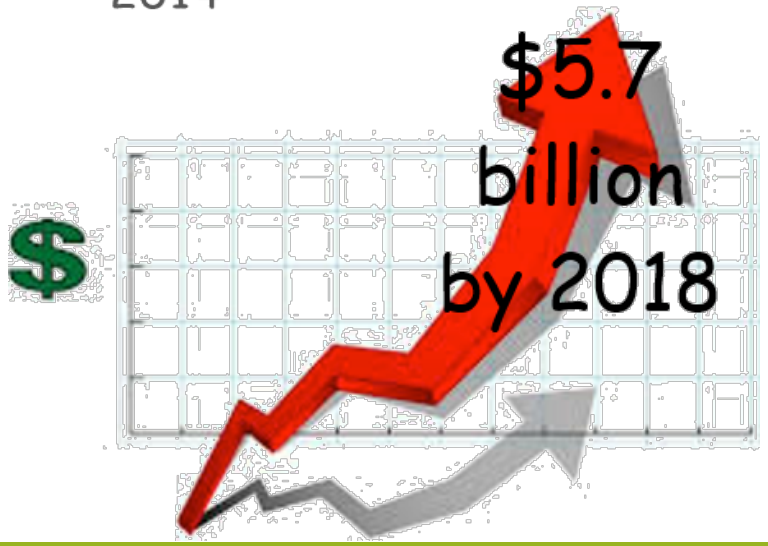
WHAT'S THE TRUTH ABOUT 3D PRINTING?



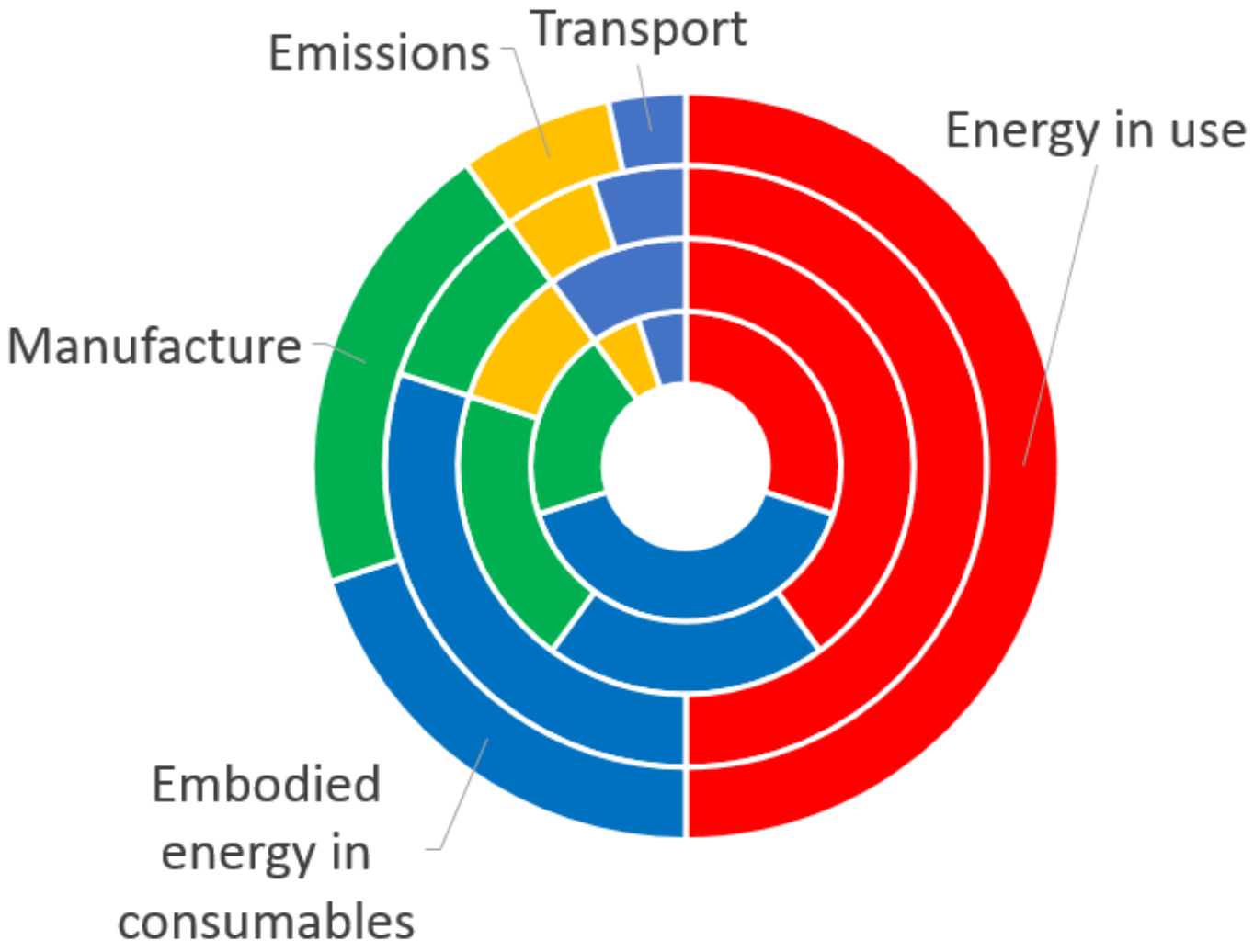
WHAT'S THE TRUTH ABOUT 3D PRINTING?

- Some change likely but a complete shift unlikely

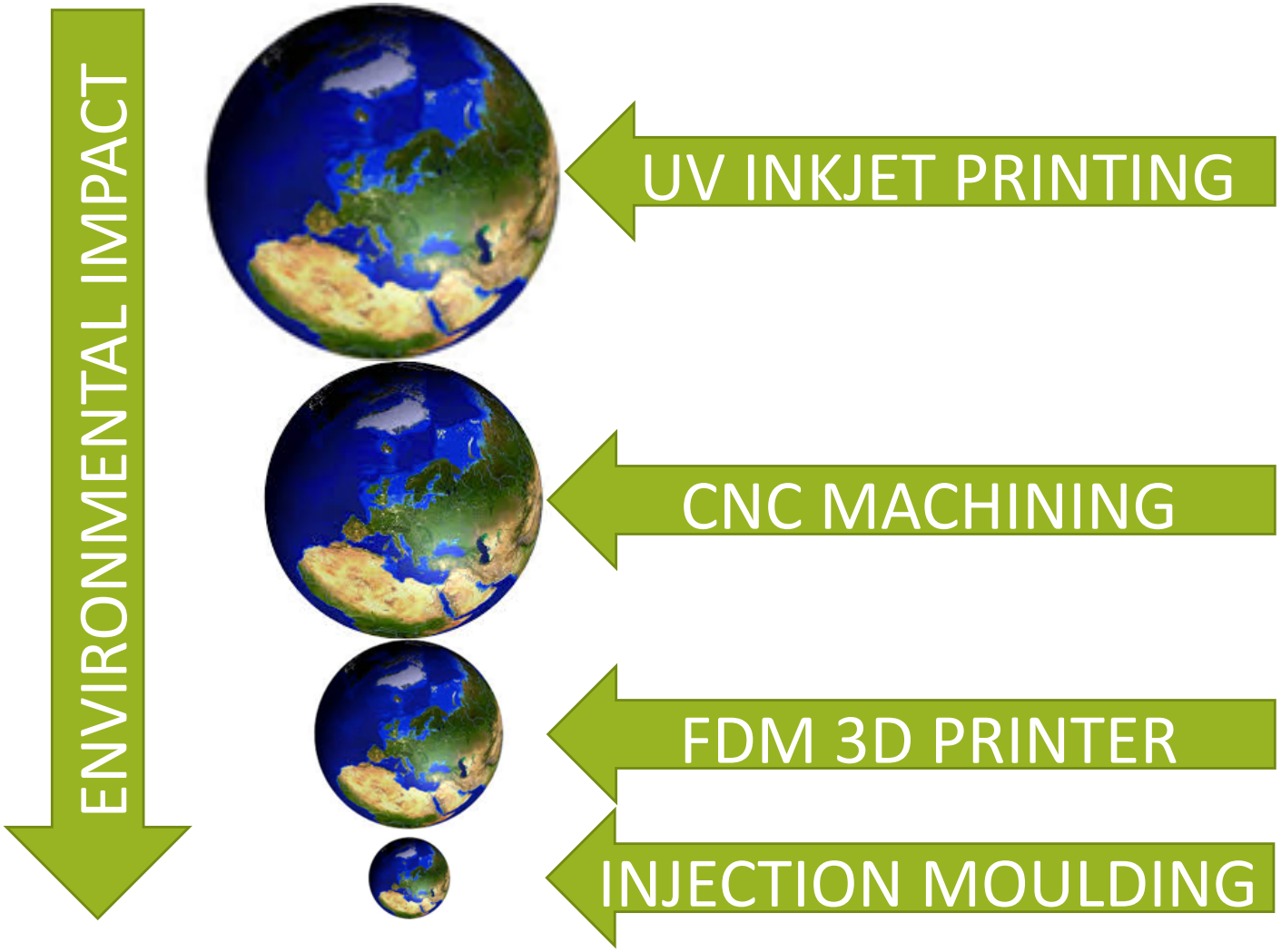




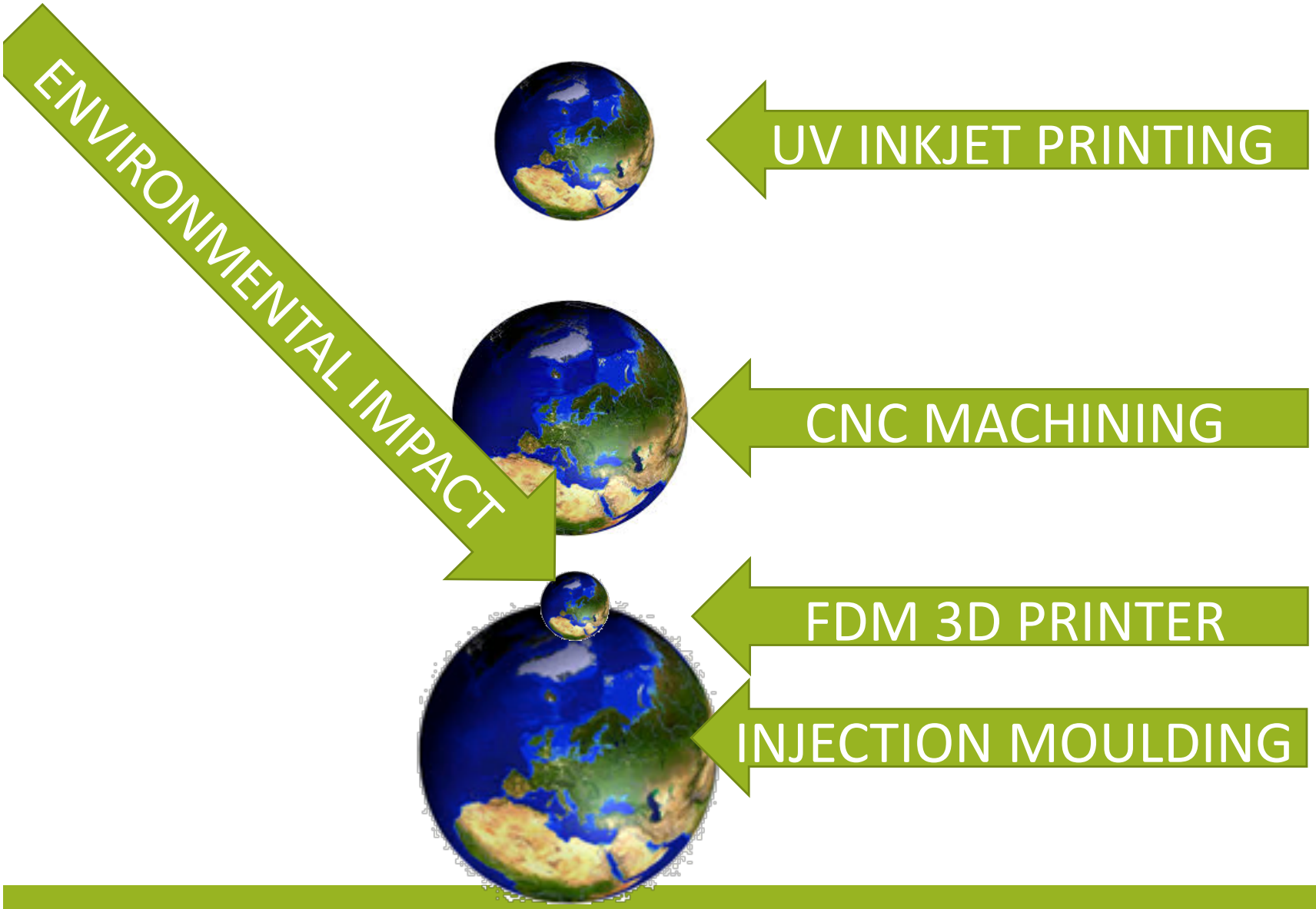
WHAT ARE THE ENVIRONMENTAL IMPACTS?



COMPARISON OF ENVIRONMENTAL IMPACTS



COMPARISON OF ENVIRONMENTAL IMPACTS



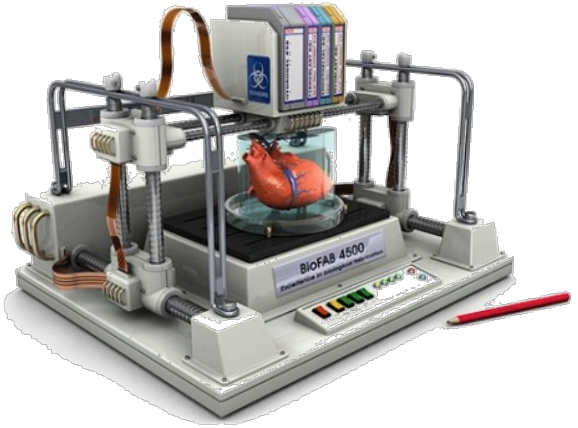
IN-USE ENERGY IMPACTS OF 3D PRINTING

REDUCING THE IMPACTS OF 3D PRINTING

- **Energy use**
  - Energy is the area where the biggest savings can be made.
    - Reduce active print time per part
    - Hollow parts and supports rather than solid
    - Optimised layer thickness
    - Optimised orientation / max parts per print
    - Optimise utilisation levels to reduce idle/ standby time

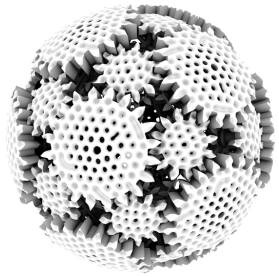
REDUCING THE IMPACTS OF 3D PRINTING

- **Materials**
  - Material choice
  - Reduce shrinkage
  - Reduce emissions
  - Reduce embodied energy
  - Finishing needs
  - Reduce melting point and density



REDUCING THE IMPACTS OF 3D PRINTING

- **Waste**
  - Selection of the lowest-waste printing technology/model
  - Purchase of feedstock from suppliers that offer cartridge and/or waste return
  - Use recycled feedstock
  - Refine printer set up to ensure achievement of the best print quality



MANY FACTORS INFLUENCE ENVIRONMENTAL IMPACTS

Utilisation	Durability	Emissions
Build Volume		Embodied Energy
Layer Thickness		Waste material
Process Time	End Product	Material Type

HOW CAN 3D PRINTING IMPROVE THE SUSTAINABILITY OF PRODUCTION?

- Answer will vary depending upon application and usage levels – customisation biggest opportunity.
- Major barriers for 3D printing to replace traditional manufacture techniques

HOW CAN 3D PRINTING IMPROVE THE SUSTAINABILITY OF PRODUCTION?

3D printing has been hyped as though it's going to replace traditional manufacturing, and at some point that could be, but I think the sweet spot in the next few years will be **a combination of 3D printing and traditional manufacturing – and really leveraging the advantage of each.**" Todd Ramsburg, Advanced Mechanical Fabrication Group

IN CONCLUSION….

- It’s an evolution not a revolution.
- In-use energy largest impact – focus here for savings.
- Proactive consideration of environmental factors from the outset of manufacturing process / product design.
- Greater research into potential to reduce manufacturing impacts – case studies.

CONTACT US FOR FURTHER INFORMATION:

- Catriona McAlister - Sea Green Tree - Consulting
- Tel: +44(0)141 416 1442
- catriona.mcalister@seagreentree.com

- Jonathan Wood - Tenvic Ltd – Consultancy
- Tel: +44(0)207 193 8442
- jonathan.wood@tenvic.com